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## FOREST PEST LEAFLET 26

# *Fusiform Rust of Southern Pines*

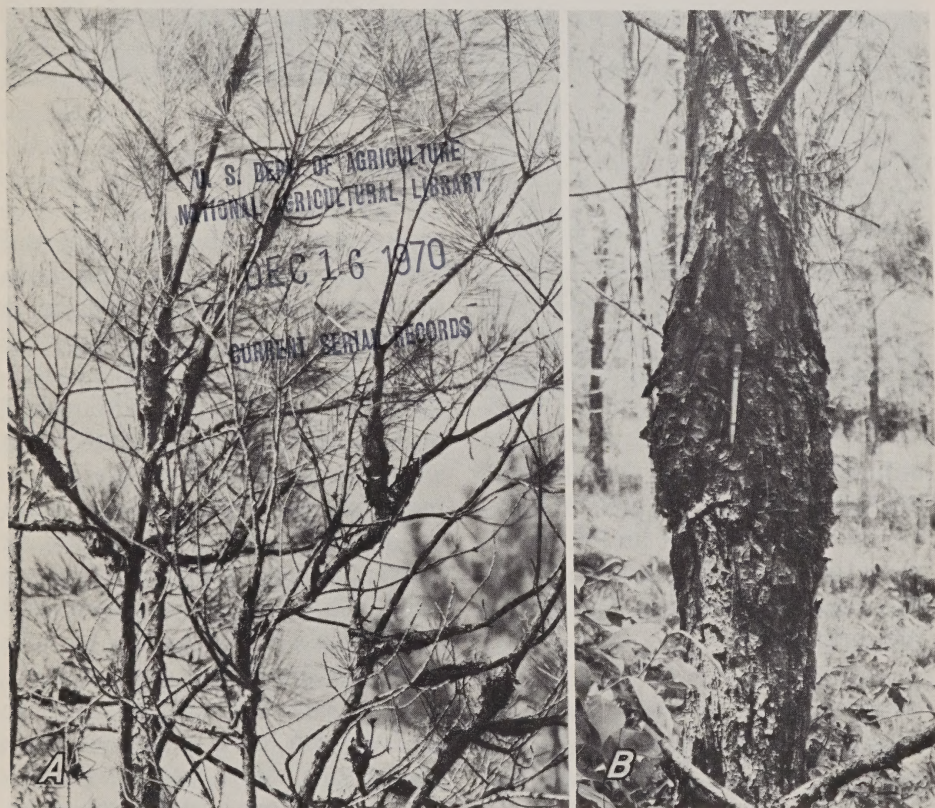
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Fusiform rust, caused by the fungus *Cronartium fusiforme* Hedgc. & Hunt ex Cum., is distributed in the Southern United States from Maryland to Florida

and west to Texas and southern Arkansas. The fungus causes a tapering, spindle-shaped swelling, called a gall, on branches and stems of pines (fig. 1).

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Figure 1.—Fusiform rust on southern pines: A, Numerous infections (galls) on loblolly pine; B, large canker ruining lower bole of loblolly pine.

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Figure 2.—Windbreakage of slash pine at fusiform rust cankers.

The disease kills many 1- to 5-year-old pines and often deforms stems, reduces growth, and increases potential windbreakage of older trees (fig. 2). It is estimated that fusiform rust causes more than \$10 million worth of damage annually in southern forests. The disease is a major obstacle to plantation establishment and management in the Gulf States and on the Coastal Plain in the South Atlantic States.

#### Hosts

The fungus requires an alternation of hosts to complete its life cycle. Part of the cycle is spent in the living tissues of pine stems and branches; the remainder, in the green leaves of several species of oaks.

Two of the important southern pines, loblolly and slash, are the

most susceptible hosts. Pitch and pond pines are also susceptible to fusiform rust. Longleaf pine is relatively resistant, and shortleaf pine apparently is highly resistant to fusiform rust. Shortleaf pine is sometimes infected with a similar, but usually less-damaging rust caused by *Cronartium quercuum* (Berk.) Miyabe ex Shirai, which produces globose galls. This disease, eastern gall rust, occasionally occurs on loblolly and slash pine also.

Black oaks are more susceptible to fusiform rust infection than white oaks. Most susceptible are water, willow, and laurel oaks, followed by bluejack, blackjack, southern red, and turkey oaks. Other oak and pine species have been infected with fusiform rust by artificial inoculation. The effect of the disease on oak hosts is



slight, although very severe infections may cause defoliation.

### Life Cycle

From late March to early April, the galls on infected pines produce enormous numbers of orange aeciospores. When they are deposited on young oak leaves, the spores germinate and produce localized infections. In a week to 10 days, the fungus produces a small pustule bearing orange urediospores on the lower surface of the leaf. These urediospores can cause infections on the same leaf or on other oak leaves. They are often referred to as the repeating stage of the fungus. About a week later, the fungus produces brown, hairlike structures called telia on the lower surface of the leaf (fig. 3). These structures are not necessarily associated with the uredial pustules. Depending on the severity of infection, each leaf may have only a few or several hundred telia. Each telium is made up of several hundred teliospores, which may remain viable until early June. When conditions are favorable (temperatures between 60 and 80° F. and relative humidity between 97 and 100 percent for 4 or more hours), the teliospores germinate, and each produces four sporidia. The sporidia are carried by air currents. When they germinate on cotyledons or needles of susceptible pines or on succulent bark tissues, the fungus grows through the tissue into the branch or stem. In 4 to 6 months, a swelling, the gall, begins to form. If the disease does not kill the pine

host during the first few months after infection, the fungus produces drops of orange fluid containing pycniospores on the gall surface. Occasionally, pycniospores are produced during the year of infection, but more often they appear from October to January of the following year. The next spring, aeciospores are produced on the gall, thus completing the life cycle.



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Figure 3.—These hairlike structures (telia) on underside of oak leaf produce the spores that infect pines.

In oaks, infection is temporary because only leaves are affected. There, the fungus usually is inactivated or killed when temperatures exceed 85° for several days. The oaks are also freed of the disease in winter, when they cast their leaves. In pines, however, the fungus persists until the infected tissues are killed; it can produce aeciospores for many years in succession.



Old galls may develop into open-faced cankers when the pine tissues are killed at the margin of the gall. These cankers are often invaded by insects and wood-rotting fungi, which further reduce the tree's value and make it susceptible to windbreakage.

### Control

The life cycle of the disease dictates the control measures that are possible.

In high-value areas, such as pine nurseries, a protective film of fungicide should be sprayed onto the pines as soon as the seeds germinate. Spraying should begin in March and continue until mid-June, whenever temperature and humidity are favorable for production and germination of sporidia. The spray mixture recommended is 2 pounds of ferbam (76 percent wettable powder) in 75 gallons of water plus 1 pint of sticker-spreader per acre. Ziram at 2 pounds of 75 percent wettable powder per 75 gallons of water may be used in place of ferbam. Commercial sticker-spreaders are usually used for convenience, but any household liquid detergent ( $\frac{1}{2}$  pint per 75 gallons) will serve as a spreader, and casein or wheat flour (1 pound per 75 gallons) may be added as a sticker. The mixture should be applied with a hydraulic sprayer operating at a minimum pressure of 300 p.s.i.

In dry weather, one spraying per week normally suffices. After a rain of  $\frac{1}{4}$ -inch or more, however, the seedlings should be resprayed as soon as possible. Thus, it is not unusual to spray three or

more times in a week during wet weather.

In spite of protective spraying considerable infection may occur in nurseries during severe rust conditions. Infected seedlings are readily recognized by the swelling on the stem near the ground line (fig. 4). These seedlings should be culled, since they rarely survive after outplanting.



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Figure 4.—Swellings on nursery stock indicate infections: A, Caused by *Cronartium fusiforme*; B, by *C. quercuum*. These seedlings will not survive outplanting.

Spraying of fungicides is not economically feasible in plantations or natural stands, thus other procedures should be followed in attempts to reduce losses caused by fusiform rust.

Avoid planting slash or loblolly pine on sites which have a previous history of severe rust infection or an abundance of sus-

ceptible oaks nearby. Longleaf or shortleaf pine are better choices for such sites.

Where local experience shows that rust hazard is moderate, satisfactory stocking can be made by planting at a closer spacing than usual to favor rapid natural pruning of laterals and thus lessen the danger of destructive trunk cankers. In addition, of course, moderate mortality from rust in a closely spaced plantation will not lead to understocking. The possibility of *Fomes annosus* (Fr.) Cke. root rot developing should not be overlooked if thinning is needed.

Cultivation and fertilizing of planted slash and loblolly pines lead to early breaking of their dormancy, which favors rust infection. Control measures such as pruning should be intensified when plantations are cultivated or fertilized in areas with appreciable rust.

Pruning branches with galls less than 15 inches from the stem will reduce the possibility of the fungus growing into the stem. Pruning is most beneficial in young plantations but is useless on trees that already have a trunk gall or canker. However, pruning may be too expensive except in high-value stands, and new infections sometimes occur even after pruning.

On a high-value tree with a small, newly-developed trunk gall, it is sometimes practical to carefully remove the bark and some of the wood around the gall, then apply a fungicidal paint, such as creosote.

Trees with trunk cankers should be salvaged in thinning, provided their removal does not open the stand more than is silviculturally desirable. Diseased trees are not a direct risk to the surrounding healthy ones since spores that infect pines come only from oak leaves. The following rule covers the period of salvageability of trunk-cankered trees: (a) Less than 50 percent of circumference killed—more than an even chance of salvage for 8 years; (b) 50 percent of circumference killed but no bend in stem at canker or sunken canker face—an even chance of salvage for 5 years; (c) 50 percent of circumference killed, with a bend at canker and either a normal or sunken canker face—less than even chance of salvage for 5 years.

Many seed orchards have been established with rust-resistant provenances of loblolly and slash pine and hybrids between one of these species and shortleaf pine. As seeds from these orchards become generally available, they should be given preference in establishing plantations in areas of high rust hazard.

### Caution

Ferbam and ziram are mild poisons.

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.



Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

**WARNING:** Recommendations for use of pesticides are reviewed

regularly. The registrations on all suggested uses of pesticides in this publication were in effect at press time. Check with your County Agricultural Agent, State Agricultural Experiment Station, or local forester to determine if these recommendations are still current.

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